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SIMULTANEOUS OBSERVATION OF MICROSEISMIC WAVES AT TWO STATIONS

BY

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1. Introduction

To investigate the origin of microseisms many seismologists have observed the arrival direction of microseismic waves by the three means, that is, the tripartite method, the Rayleigh wave technique and the ground particle motion analysis. The writer also employed these three means for the determination of the arrival direction. But the tripartite method did not bring good results, probably because each phase identified at the three observation points is not always the same due to the respectively different superposition of waves propagated from several directions. And the Rayleigh wave technique, for example, the Lee's method was impossible to indicate the predominant direction of propagation. Fig. 1 shows the frequency of phase differences between each component of the seis-

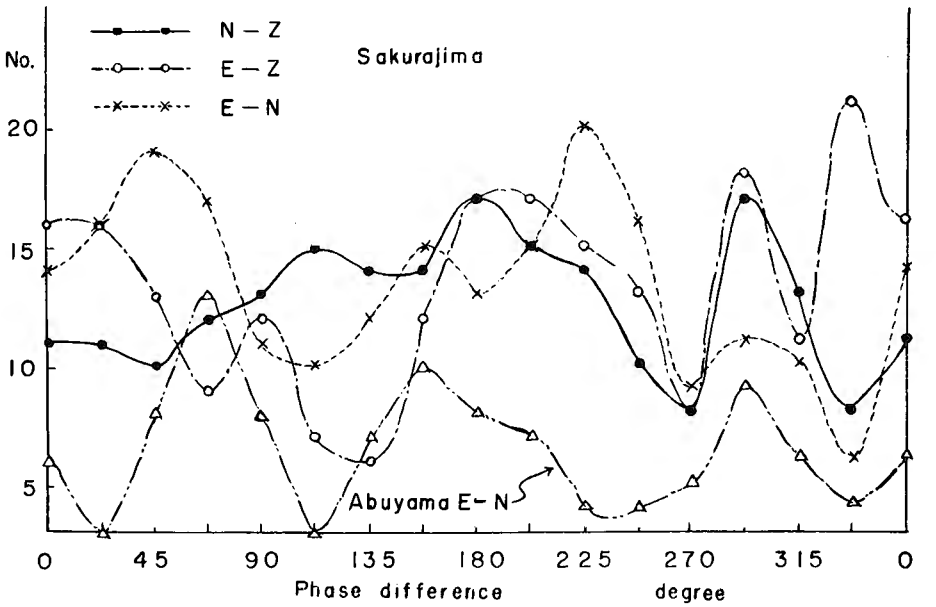


Fig. 1 The frequency of phase differences between the components of microseismic waves.

mograms at Sakurajima and Abuyama stations. On the other hand, the particle motion analysis brought so successful results and hence it is intended to improve this method for the further study of microseisms (Okano 1961 a and b).

If the arrival directions of microseismic waves are observed simultaneously at two points, the origin of microseisms may be effectively determined. Nevertheless, there are few studies in this connection. Because the identification of wave at two points was impossible. Hollinderbäumer (1959) investigated the origin from a intersection of the predominant arrival directions obtained from the ratio of maximum amplitude of NS and EW components observed in Hamburg and Kopenhagen. But he did not observe the identical wave propagated from the origin to the two stations. The writer observed previously the single wave of typical Rayleigh motion by recording trajectories of the ground motion. And hence he considered that if the observation of particle motions of the ground is simultaneously carried out at two points, the successful result may be obtained.

2. Observation methods and results

The observation was taken at the Abuyama Seismological Observatory in Osaka Pref. and the Kyoto University in Kyoto Pref. According to the writer's opinion microseisms occur most predominantly off the coast of the Yosa Peninsula in Kyoto Pref. in winter, and such waves arrive nearly at the same time at Abuyama and Kyoto. Therefore, he expected a possibility of observing the identical wave at the both stations.

The instruments used for the observation are the vector seismographs with a pendulum period of 4.0 s and a galvanometer period of 10.0 s, which are the same he used in the case of his earlier observations (1961). The ground particle trajectories in a horizontal and one vertical (UD–NS) planes were recorded at Abuyama, and those only in a horizontal plane at Kyoto.

This method of origin determination was applied to the two microseismic storms, both generated by seasonal winds mainly in the Japan Sea. One of them was recorded during about 2.5 hours on Oct. 3 1961, and another 1.5 hours on Oct. 10 1961.

We notice by comparison of the seismograms of both stations that the two orbits are hardly similar in appearance of record and hence the identification of wave is quite impossible. So the writer picked out the waves of linear orbit in a horizontal plane and nearly elliptical one in a vertical plane from the seismograms of Abuyama and then he examined the seismograms of Kyoto if the linear orbit was possible to be identified at about same time when the linear orbit was recorded on the horizontal vector seismograms of Abuyama. But this procedure was not

successful. An example of seismograms showing the admissible identification of wave is presented in Fig. 2. Finally the determination of the origin of microseisms was scarcely possible, because there were few orbits to be successful to making the intersection from the two linear orbits at the two stations.

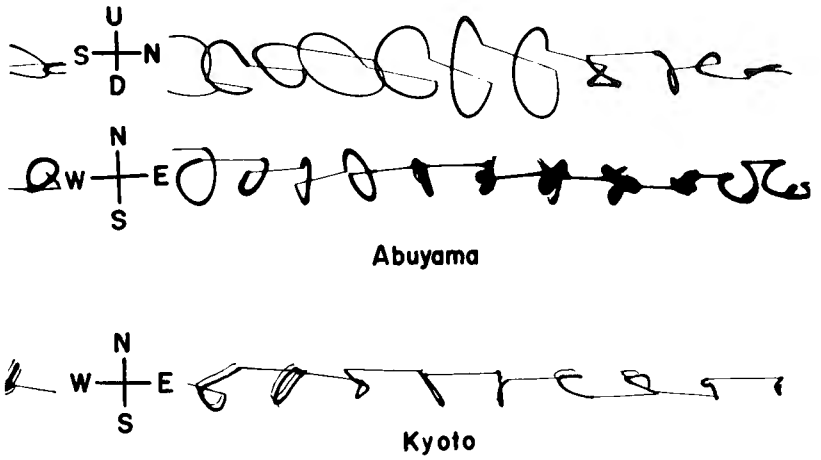
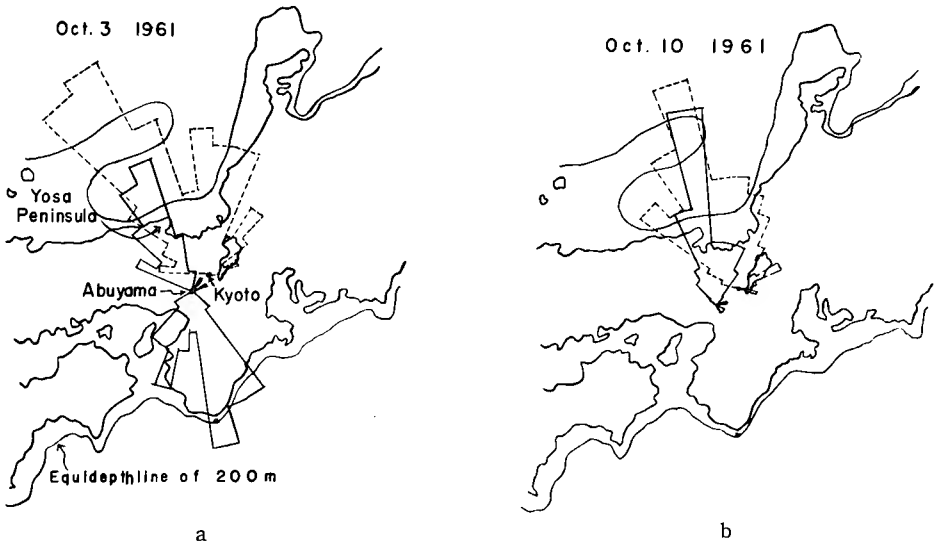


Fig. 2 Vector seismograms recorded simultaneously at Abuyama and Kyoto.

3. The frequency distribution of arrival directions at Abuyama and Kyoto

The frequency distribution of arrival directions of microseismic waves were made from the vector seismograms of Abuyama and Kyoto. The distributions



a b

Fig. 3 The frequency distribution of arrival directions of microseismic waves at Abuyama and Kyoto.

are shown Fig. 3 a and b. As it was impossible to discriminate the microseismic waves of the Japan Sea from those of the Pacific for the lack of seismograms in a vertical plane at Kyoto station, all microseismic waves recorded in Kyoto were regarded as propagated from the Japan Sea. As seen from these two figures, the directions of maximum frequencies at Abuyama and Kyoto differ by about ten degrees, and those two predominant directions intersect with each other off the coast of the Yosa Peninsula. There is the district with the continental shelf of steep inclination. This coincided with the inference drawn from the writer's studies. But the origin of microseisms was not proved clearly whether it is near the coast or near the continental margin.

4. Simultaneous observations of microseismic waves by usual seismographs

As the vector seismograms at the two stations were unexpectedly different in appearance from each other, the writer examined the identification of the waves at Abuyama and Kyoto about the seismograms in NS component. A portion of seismograms is reproduced in Fig. 4. The microseismic waves gave the different appearance at the two stations, and it was impossible to identify the waves.

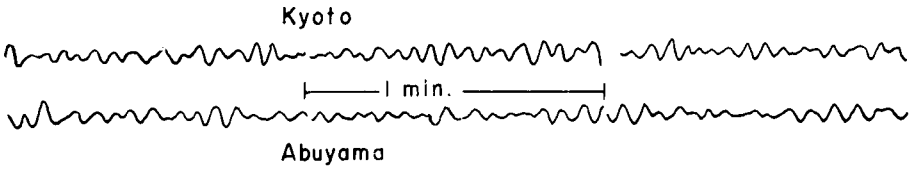


Fig. 4 Seismograms in NS component recorded simultaneously at Abuyama and Kyoto.

5. Conclusion

Since the microseismic waves generated off the coast of the Yosa Peninsula were considered to arrive nearly at the same time at Abuyama and Kyoto, it was expected that we are possible to observe the identical single waves at the two stations and to determine the origin from those two arrival directions. However, on account of the great complexity of ground oscillations by microseisms, the observation was fruitless. He considered that this complexity is due to rather the respective different wave-interference than the heterogeneity of the earth's crust, and he will leave the origin determination by this procedure to some other day.

There are two ways for the study of microseisms. One is the statistical means and other is the investigation on the single wave picked out from numerous superposed waves. To use vector seismographs, especially with a vertical plane component, gives promise of picking out the single waves. The writer wishes to make a further study of microseisms by the latter way.

The writer wishes to express his gratitude to Professor Kenzo Sassa of Kyoto University for his invaluable advice and encouragement. The writer also express his hearty thanks to Mr. K. Ito for the observations.

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